

CLAIMS

1. A method for cleaning a vessel contaminated with a sludge comprising the steps of:-

- i) generating a vacuum in a conduit;
- ii) contacting said sludge with said conduit;
- iii) extracting said sludge via said conduit; and
- iv) collecting the sludge.

2. A method as claimed in claim 1, wherein the vacuum is generated pneumatically.

3. A method as claimed in claim 2, wherein the vacuum is generated by a pump.

4. A method as claimed in any one of claims 1 to 3 comprising the step of contacting the sludge with a solvent.

5. A method as claimed in claim 4, wherein the solvent comprises a citrus oil extract.

6. A method as claimed in claim 5, wherein the solvent is orange oil.

7. A method as claimed in any one of the preceding claims wherein the sludge is heated to a temperature in the range of 40 - 90°C.

8. A method as claimed in claim 7, wherein the sludge is heated to a temperature in the range of 65 - 75°C.

9. A method as claimed in any one of the preceding claims wherein the sludge comprises one or more of the group comprising asphalt, bitumen, crude oil and heavy oil.

10. An apparatus for cleaning a vessel contaminated with a sludge,

comprising means for generating a vacuum, a conduit connected to said means for generating a vacuum adapted to extend into the interior of the vessel from said means for generating a vacuum, and to extract the hydrocarbon and means for collecting the extracted hydrocarbon.

11. An apparatus as claimed in claim 10, wherein the vacuum is generated pneumatically.

12. An apparatus as claimed in claim 10 or 11, further comprising means for heating the hydrocarbon before and/or during extraction.

13. An apparatus as claimed in claim 12, wherein the means for heating the hydrocarbon comprises a microwave emitter or heated oil.

14. An apparatus as claimed in claim 12 or 13, wherein said means for heating the hydrocarbon is disposed adjacent to an opening in the conduit.

15. An apparatus as claimed in any one of claims 9 to 14, wherein the apparatus is portable.

16. An apparatus substantially as described herein with reference to, and as illustrated by, the accompanying drawings.

17. A method for extracting hydrocarbons from waste material comprising the steps of:

- i) identifying waste material with an economically valuable or environmentally hazardous concentration of hydrocarbons;
- ii) treating the waste material to render the hydrocarbons more susceptible to extraction;
- iii) extracting the hydrocarbons from the waste material;
- iv) optionally further processing the extracted hydrocarbons into a

usable product.

18 A method as claimed in claim 17, wherein the hydrocarbons in the waste material comprise more than 20% hydrocarbon oil by volume.

19. A method as claimed in any one of claims 17 or 18, wherein the treatment of the waste material to render the hydrocarbons more susceptible to extraction comprises the use of heat and/or solvents.

20. A method as claimed in any one of claims 17 to 19 wherein the extracted hydrocarbons are mixed with bitumen.

21. A method as claimed in any one of claims 17 to 20, wherein the hydrocarbons are heated to a temperature of 40 - 90°C.

22. A method as claimed in claim 21, wherein the hydrocarbons are heated to a temperature of 65 - 95°C.

23. A method as claimed in any one of claims 17 to 22, wherein the average percentage of hydrocarbons by volume in the waste material is at least 50%.

24. A method as claimed in any one of claims 17 to 23, wherein the hydrocarbon is heated to a depth of between 20 - 60cm from the upper surface of the sludge.

25. A method as claimed in claim 24, wherein the hydrocarbon is heated to a depth of between 40 - 45cm.

26. A method as claimed in any one of claims 17 to 25, wherein the waste material comprises one or more from the group comprising asphalt, bitumen, heavy fuel oil, crude oil, animal fats and vegetable oil.

27. A method for extracting hydrocarbons from solid waste material

comprising the steps of:

- i) mixing the solid waste material with a solvent;
- ii) extracting the majority of the hydrocarbons from the mixture;
- iii) heating the remaining waste hydrocarbons in the mixture to a temperature of at least 40°C;
- iv) extracting the remaining waste hydrocarbons;
- v) optionally further processing the extracted hydrocarbons into a

usable product.

28. A method for extracting hydrocarbons from sludge comprising the steps of:

- i) heating the waste hydrocarbons to a temperature of at least 40°C;
- ii) extracting the majority of the hydrocarbons
- iii) mixing the remaining waste hydrocarbons with a solvent;
- iv) extracting the remaining waste hydrocarbons;
- v) optionally further processing the extracted hydrocarbons into a

usable product.

29. A method for extracting hydrocarbons from sludge comprising the steps of:

- i) identifying sludge comprising more than 20% hydrocarbons by volume;
- ii) heating said waste hydrocarbons to a temperature of at least 40°C;
- iii) extracting said heated waste hydrocarbons;
- iv) optionally further processing the extracted hydrocarbons into a

usable product.

30. An apparatus for extracting recyclable hydrocarbons from waste hydrocarbons contaminated with aggregate comprising:

means for heating said hydrocarbons to a temperature of at least 40°C and
means for extracting and/or transferring said heated waste hydrocarbon to a storage means.

31. An apparatus as claimed in claim 30, wherein the means for heating comprises a coil or a bank of tubes having a circulating liquid of thermal oil/vapour/gas or electric elements.

32. An apparatus as claimed in claim 15, wherein the means for heating comprises oil filled tubes.

33. A method for extracting hydrocarbons from solid waste material comprising the steps of:

- i) mixing the solid waste material with a solvent;
- ii) extracting the hydrocarbons from the mixture;
- iii) optionally further processing the extracted hydrocarbons into a usable product.

34. A method as claimed in claim 33, wherein the solid waste material comprises bitumen, asphalt and compacted oily sand.

35. A method as claimed in claim 33 or 34, wherein the solvent comprises one or more selected from the group comprising aqueous solvent, non-aqueous solvent and water.

36. A method as claimed in claim 35, wherein the solvent is an orange oil derivative, aliphatic hydrocarbon, aromatic hydrocarbon or a chlorinated solvent.

37. An apparatus for filtering air said apparatus comprising a plurality of

chambers which communicate with one another in series, such that air can pass from one chamber to another, each of which comprises means for generating a vortex.

38. An apparatus as claimed in claim 37, wherein the means for generating a vortex comprises at least one conical plate.

39. An apparatus as claimed in claim 38, wherein the at least one conical plate comprises a drainage channel.

40. An apparatus as claimed in claim 38 or 39, wherein the at least one conical plate is perforated, solid or slatted.

41. An apparatus as claimed in any one of claims 37 to 40 comprising means for externally spraying the plurality of chambers with cooling fluid.

42. An apparatus as claimed in claim 41, wherein the means for externally spraying the chambers comprise spray nozzles.

43. An apparatus as claimed in claim 41 or 42 wherein the cooling fluid comprises water, hydrocarbon solvent or liquefied gas.

44. An apparatus as claimed in any one of claims 37 to 43, wherein the number of chambers in the apparatus is in the range of 5 to 15.

45. An apparatus as claimed in claim 44 wherein the number of chambers is in the range of 7 to 9.

46. An apparatus as claimed in claims 41 to 45 wherein the first chamber is not cooled with external cooling fluid.

47. An apparatus as claimed in any one of claims 37 to 46 wherein the height to diameter ratio of the chamber is in the range of 4:1 to 6:1.

48. An apparatus as claimed in claim 47, wherein the height to diameter

ratio of the chamber is 5:1.

49. An apparatus as claimed in any one of claims 37 to 48 wherein the means for generating a vortex is dispersed with each chamber at the same height from the bottom of the chamber or linearly staggered.

50. An apparatus as claimed in any one of claims 37 to 49 wherein each chamber comprises an inlet and an outlet.

51. An apparatus as claimed in claim 50, wherein the means for generating a vortex is disposed in the range 5 to 35cm below the inlet pipe.

52. An apparatus as claimed in claim 50 or 51 wherein the outlet pipe is disposed above the inlet pipe.

53. An air conditioning system comprising an apparatus as claimed in any one of claims 37 to 52.

54. An apparatus for filtering gas comprising one or more contaminants, said apparatus comprising a plurality of chambers which communicate with one another in series, such that gas can pass from one chamber to another, at least one of the chambers comprising an inlet port, an outlet port, an internal baffle and a receiving region below the baffle for receiving contaminants, wherein said outlet port is disposed above said baffle such that gas can pass from one chamber to another whilst contaminants are retained in the receiving region of the chamber.

55. An apparatus as claimed in claim 54 wherein the baffle is shaped to generate a vortex.

56. An apparatus as claimed in claim 55, wherein the baffle is conical in shape.

57. An apparatus as claimed in any one of claims 54 to 56, wherein the

contaminants are solids and/or liquids.

58. An apparatus as claimed in any one of claims 54 to 56 wherein the contaminants contain one or more hydrocarbons.

59. A method of filtering air comprising the use of an apparatus as claimed in any one of claims 37 to 58.

60. A method of extraction as claimed in any one of claims 17 to 26 comprising between steps I) and ii) a method as claimed in any one of claims 1 to 9.

61. A method of extraction as claimed in any one of claims 1 to 9 subsequently comprising the method of claim 27.

62. A method of extraction as claimed in claim 28 wherein steps I) and/or ii) comprise the method of any one of claims 1 to 9.

63. A method of extraction as claimed in claim 29 wherein steps ii) and/or iii) comprise the method of any one of claims 1 to 9.

64. A method of extraction as claimed in any one of claims 1 to 9 subsequently comprising a method as claimed in any one of claims 33 to 36.

65. A method of extraction as claimed in any one of claims 17 to 26 subsequently comprising the method of claim 59.

66. A method of extraction as claimed in claim 27 subsequently comprising the method of claim 59.

67. A method of extraction as claimed in claim 28 subsequently comprising the method of claim 59.

68. A method of extraction as claimed in claim 29 subsequently comprising the method of claim 59.

69. A method of extraction in any one of claims 33 to 36 subsequently comprising the method of claim 59.

70. A method of extraction as claimed in claim 60 further comprising the method of claim 59.

71. A method of extraction as claimed in claim 61 further comprising the method of claim 59.

72. A method of extraction as claimed in claim 62 further comprising the method of claim 59.

73. A method of extraction as claimed in claim 63 further comprising the method of claim 59.

74. A method of extraction as claimed in claim 64 further comprising the method of claim 59.

75. An extraction system comprising apparatus as claimed in any one of claims 10 to 16 further comprising an apparatus as claimed in any one of claims 30 to 32.

76. An extraction system comprising apparatus as claimed in any one of claims 30 to 32 further comprising an apparatus as claimed in any one of claims 37 to 58.

77. An extraction system comprising apparatus as claimed in any one of claims 10 to 16 further comprising an apparatus as claimed in any one of claims 30 to 32 and/or an apparatus as claimed in any one of claims 37 to 58.

78. A method as claimed in any one of claims 1 - 9 comprising the method of claim 59.